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FC-301/D
USER MANUAL

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SPECIFICATION

GENERAL

Equipment Type……Data Radio

Performance Specification…….....TIA/EIA-603 & ETS 300-113

Band ……..UHF/VHF

Channel Spacing……25KHz,12.5KHz programmable

RF Output Power……1W - 5W Programmable

Modulation type ……..16K0F3E,8K5F3E

Intermediate Frequency…… 45.1MHz & 455KHz

Number of Channels……16

Frequency Source ……Synthesizer

Operation Rating……Intermittent

5:5:90 (TX: RX: Standby)

Power Supply ……12.5V DC Nominal Voltage

Temperature Range

Storage……from –40°C to +80°C

Operating……from –30°C to +70°C

Current Consumption

Standby (Muted) ……≤40mA

Transmit 5 Watts RF Power ……< 1.5A

Transmit 1 Watt RF Power……<0.8A

Frequency Bands ……RX UHF: 400 – 470 MHz VHF: 136 – 174 MHz

……TX UHF: 400 – 470 MHz VHF: 136 – 174 MHz

Dimensions……(120mm)L x (60mm)W x (20mm)H

Weight……≤150 grams

TRANSMITTER

Sustained Transmission…… Nominal conditions

Time:	5	10	30 sec
Power:	>95%	>95%	>90%

Frequency Error……±2.5 ppm

Frequency Deviation:

25kHz Channel Spacing……≤±5.0kHz,

12.5kHz Channel Spacing……≤±2.5kHz,

Audio Frequency Response…… Within +1/-3dB of 6dB octave

@300Hz to 2.55kHz for 12.5kHz C.S
@300Hz to 3.0khz for 25kHz C.S

Adjacent Channel Power

25kHz……< 70 dBc @ Nominal Condition

<65 dBc @ Extreme Condition

12.5kHz ……< 60 dBc @ Nominal Condition

< 55 dBc @ Extreme Condition

Conducted Spurious Emission ……< -36 dBM

Modulation Sensitivity…… 100mV RMS@60% peak Dev.

Hum & Noise:

25kHz Channel Spacing……>40 dB (with no PSOPH)

12.5kHz Channel Spacing……>36 dB (with POSPH)

Modulation Symmetry ……..<10% Peak Dev@1kHz input for nominal dev +20dB

Load Stability……No osc at >= 10:1 VSWR all phase angles and suitable antenna
No destroy at >= 20:1 all phase angle

RECEIVER

Sensitivity(12dB Sinad) ……UHF <-117 dBm, VHF<-118dBm@Nom.Condition

Amplitude Characteristic……..<±3dB

Adjacent Channel Selectivity:

25 kHz Channel Spacing ……≥70dB @ Nom.

12.5kHz Channel Spacing……≥60dB@Nom.

Spurious Response Rejection……70dB

Image Response…… > 70 dB

IF Response …… >70 dB

Others……> 70 dB

Intermodulation Response Rejection……≥65 dB

Conducted Spurious Emission @ Nominal Conditions……<−57 dBm

AF Distortion .....<5% @ Nom., <10%@ Extreme Condition

RX Hum & Noise:

25.0kHz CP.....< 40dB No PSOPH

12.5kHz CP .....< 40dB with PSOPH

Receiver Response Time .....< 20ms

Squelch Opening sensitivity: .....−118dBm

Squelch Closing sensitivity ..... −121dBm

Squelch Attack Time:

RF Level at Threshold ..... <40ms

RF Level at Threshold +20dB.....<30ms

L.O. Frequency Temperature Stability.....1 st <2.5 ppm,
2 nd <10 ppm for –30°C to +70°C

L.O. Frequency Aging Rate.....±2 ppm/year

REFERENCE CRYSTAL

Frequency..... 13MHz

Temperature Characteristic.....+/- 2.5PPM
from –30°C to +70°C

Aging Rate.....< 2ppm/year in 1 st year
<1ppm/year thereafter

Lock Time .....<10 ms

TX to RX ..... < 20 ms

RX to TX ..... < 25 ms

ENVIRONMENTAL (performance without degradation unless stated)

Temperature..... deg C

Operating.....−30° to +70°C Degradation

Specified@Extreme

Storage ..... −40°C to +80°C

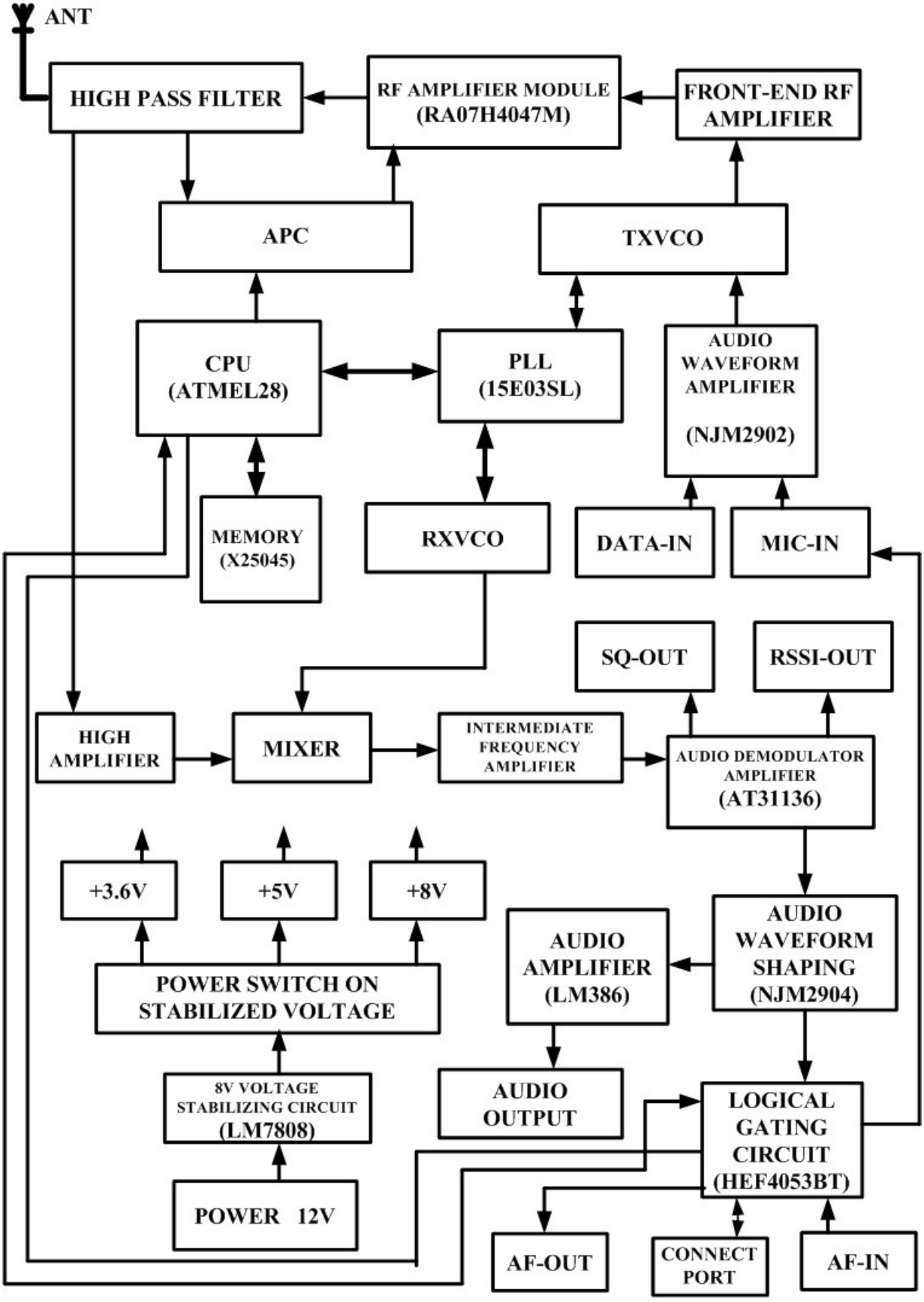
Recharging ..... −10 to +55

ESD..... 20kV (C-MIC >= 15kV)

Vibration..... MIL STD 810 C Procedures I,II,V and IEC68 26

• Due to continuing researching and development the company reserves the right to alter these specifications without prior notice.

FC-301D CIRCUIT DIAGRAM



INTRODUCTION

The FC-301D Series of RF Link Modules from Friendcom utilizes the latest technology in its design and manufacturing. Both the UHF and VHF models are PLL (Phase Lock Loop Synthesizer) / microprocessor controlled, and offer one to five watts of power with 16 channel capability. Multiple functions including AC audio coupling, 1200 to 9600 baud rates GMSK and FSK modulation capability are standard in these fully programmable wide bandwidth RF Link Module units.

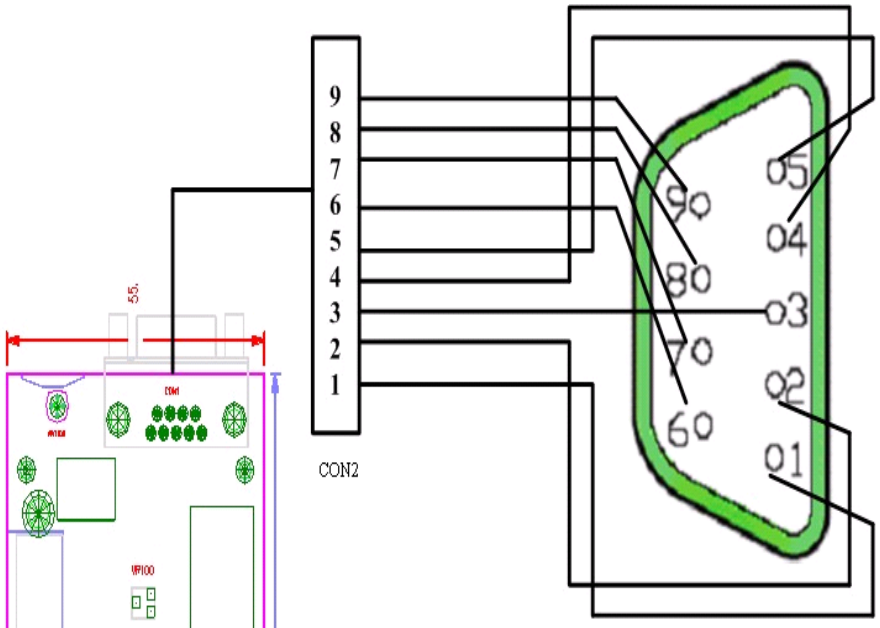
FEATURES

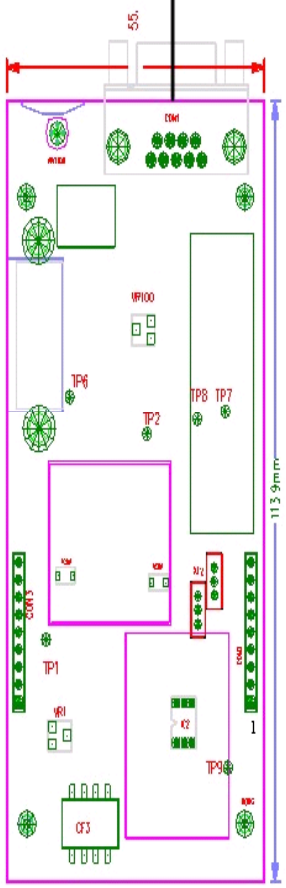
- **16 Channels**
- **1- 5 Watt Programmable Output**
- **12.5 / 25 kHz Programmable Channel Spacing**

TROUBLESHOOTING GUIDE

SYMPTOM S	CAUSES	COUNTERMEASURES
Unit does not work	1.No power incomplete connection 2. No input voltage of 5V or 8V 3. CPU does not work 4. EEPROM fail 5. Channel error 6. PLL error	1.Check COM1 connection 2. Check IC500、IC504 3. Check IC510 4. Check IC502 5. Check CF3 6. Check TCXO、VCO、PLL IC
Bad RX Sensitivity	1.Antenna signal short-circuit 2.Antenna signal open-circuit 3. Bad electronic turner 4. Defective high frequency amplifier 5. Bad mixer 6. Local signal amplitude become small 7. Bad 1^{st} and 2^{nd} intermediate frequency	1. Check D106 D107 2. Antenna loose weld 3. Check L23 L24 L25 L26 4. Replace Q15 5. Check IC3 T3 T4 6. Check D103 Q111 7. Check XF1 XF2 IC2
Defective RX	1. No output signal 2. Bad signal waveform 3. Bad stability of VCO	1. Replace IC801 2. Check U2 c412 c404 3. Check component of VCO
PLL Error	1. TCXO frequency error 2. Bad stability of VCO 3. PLL can't be locked	1.Check crystal oscillator of TCXO 2.Check the component of TX/RXVCO 3. IC301 Q321 Q320 C327
Low TX Power	1. Bad amplifier circuit 2. Bad APC circuit	1. Replace IC102 2. Check D102 IC1
No TX Power	1. No power on TX 2. No signal on driver 3. Bad amplifier circuit 4. Bad APC circuit	1. Check Q502 Q503 2. Check Q1 Q2 D101 3. Check IC102 D102 4. Check IC1
No Modulation	1. No input signal 2. No TX signal	1. Check IC801 2. Check U1 R403 R404

WIRING DIAGRAM





DIGITAL BOARD

DB9 CONNECTOR

Pin1: Audio In (Data TX)

Pin2: Audio Out (Data RX)

Pin3: PTT

Pin4: GND(Ground)

Pin5: B^{+} Power Supply

Pin6: Carrier Detect (Squelch)

Pin7: RSSI output

Pin8: Switch

Pin9: Speaker

Pin	Function	Type	Range	Description
Pin 1	Audio in(Data TX)	Input	200VP-P ------ 300VP-P	External Modulation Input
Pin 2	Audio out (Data RX)	Output	150mV-250mV	Demodulation Output
Pin 3	PTT	Input	0 V/+5V	Transmit Enable 0V - Radio in Transmit status 5V - Radio in receive status(Default)
Pin 4	GND	GND	0V	GND
Pin 5	B+	V+	10-15V	Power Supply(+12.5V typical)
Pin 6	SQ	Output	Open/Short	RF Carrier Detect Open -- low level, Short -- high level (Default).
Pin 7	RSSI	Output	0.8V-2.2V	
Pin 8	Switch	Input	0V/5V	Programming Enable 0V - Radio programmable 5V - Radio work (Default)
Pin 9	Speaker	Output	8ohm /0.5W	

FACTORY DEFAULT SETTING

FC-301D UHF RF Link Module

Channel	RX Frequency	RX Tuning Value (TV)	TX Frequency	TX Tuning Value (APC)
1	400.1250MHZ	170	400.1250MHZ	65
2	405.1250MHZ	165	405.1250MHZ	65
3	410.1250MHZ	160	410.1250MHZ	65
4	415.1250MHZ	155	415.1250MHZ	65
5	420.1250MHZ	150	420.1250MHZ	65
6	425.1250MHZ	145	425.1250MHZ	65
7	430.1250MHZ	140	430.1250MHZ	65
8	435.1250MHZ	135	435.1250MHZ	65
9	436.1250MHZ	130	436.1250MHZ	65
10	440.1250MHZ	130	440.1250MHZ	65
11	445.1250MHZ	125	445.1250MHZ	65
12	450.125MHZ	120	450.1250MHZ	65
13	455.1250MHZ	115	455.1250MHZ	65
14	460.1250MHZ	110	460.1250MHZ	65
15	465.1250MHZ	105	465.1250MHZ	65
16	469.9750MHZ	100	469.9750MHZ	65

FC-301D VHF RF Link Module

Channel	RX Frequency	RX Tuning Value (TV)	TX Frequency	TX Tuning Value (APC)
1	136.1250MHZ	0	136.1250MHZ	185
2	138.1250MHZ	0	138.1250MHZ	185
3	140.1250MHZ	0	140.1250MHZ	185
4	143.1250MHZ	0	143.1250MHZ	185
5	145.1250MHZ	0	145.1250MHZ	185
6	147.1250MHZ	0	147.1250MHZ	185
7	150.1250MHZ	0	150.1250MHZ	182
8	153.1250MHZ	0	153.1250MHZ	182
9	155.1250MHZ	0	155.1250MHZ	182
10	157.1250MHZ	0	157.1250MHZ	182
11	160.1250MHZ	0	160.1250MHZ	178
12	163.1250MHZ	0	163.1250MHZ	178
13	165.1250MHZ	0	165.1250MHZ	170
14	167.1250MHZ	0	167.1250MHZ	170
15	170.1250MHZ	0	170.1250MHZ	170
16	174.1250MHZ	0	174.1250MHZ	170

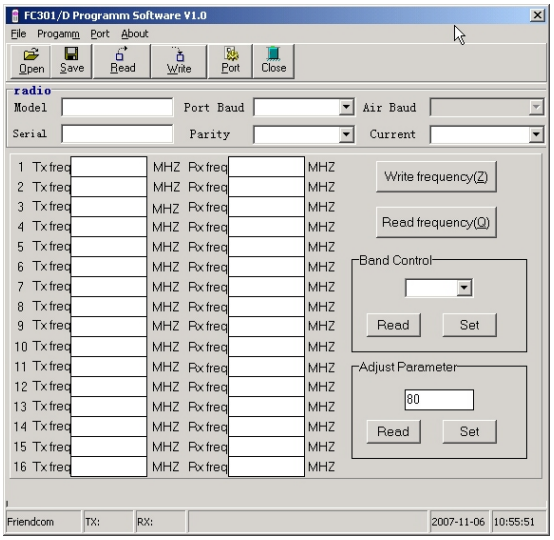
From above diagram, TX Tuning Value is based on 5W normal output power, please refer to The Manual of FC-301/D Program Software if you need other Tuning value based on other output power.

PROGRAMMING

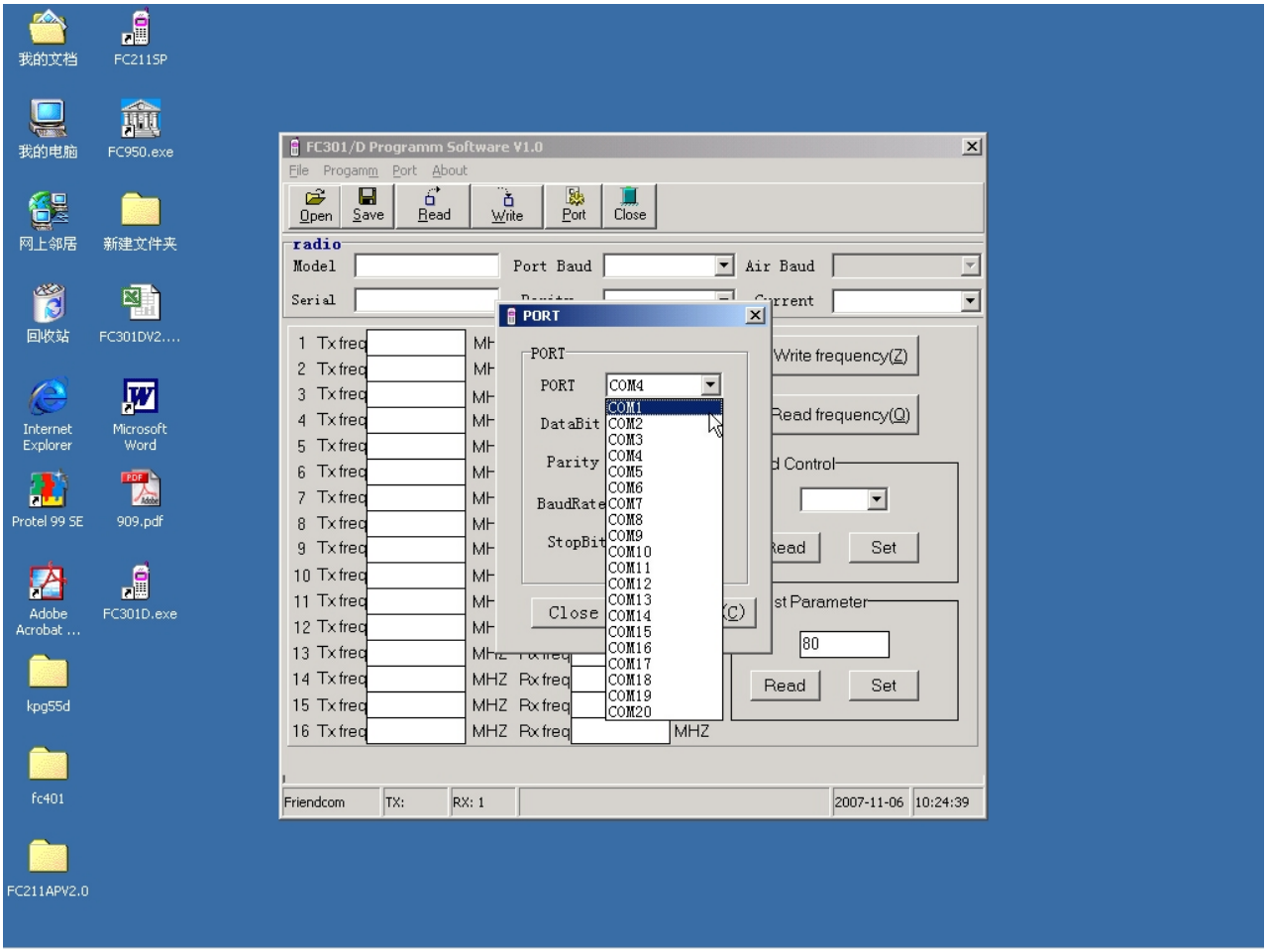
The detailed information on programming the FC-301D radio is as following procedures.

Ⅰ. To start the FC-301/D Program Software and read the parameters of FC-301/D RF Link Module

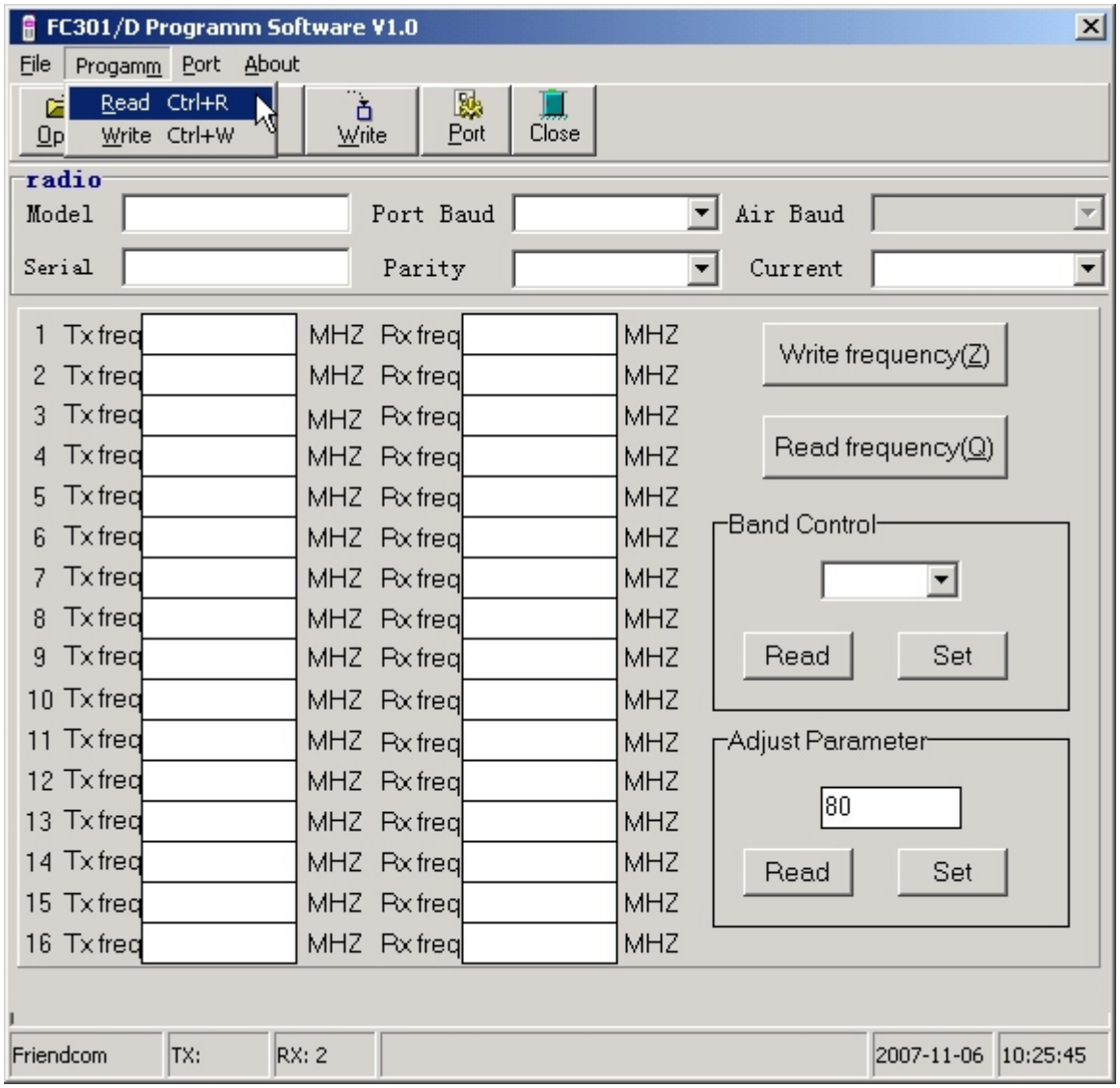
- Firstly make sure the radio FC-301/D is in programming status (pin8 SW of CON1(DB9, refer to page 43) in low level-GND), then connect DB9 connector of FC-301D with PC via programming cable(TTL to RS232）(refer to page 49.).
- Double click the "FC301D.exe". The software will enter into main interface of FC-301D as the following:



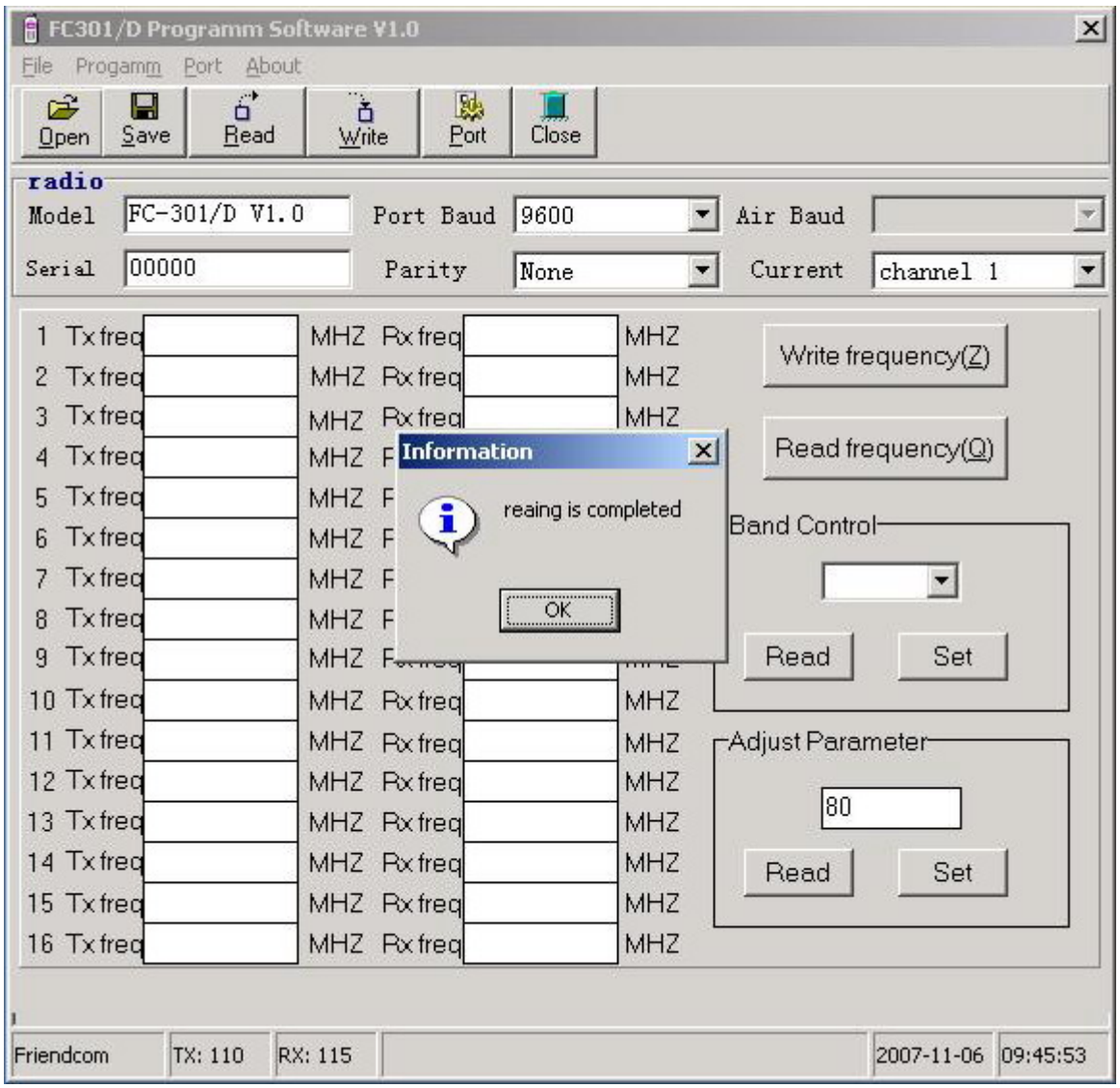
- Run the ‘Port’ in the main menu or press the Icon ‘Port ’ , The software will enter into the Port parameter setting interface.



- Run ‘ Program ’ -> ‘ Read ’ in the main menu, The software will detect and read the parameters of FC-301D.



- After run step 4, FC-301/D will automatically detect the FC-301/D RF link module and display the parameters of the module on the screen.



Ⅱ. To change the parameters of the RF link module

After reading the previous parameters, User can change the parameters of the module to new ones.

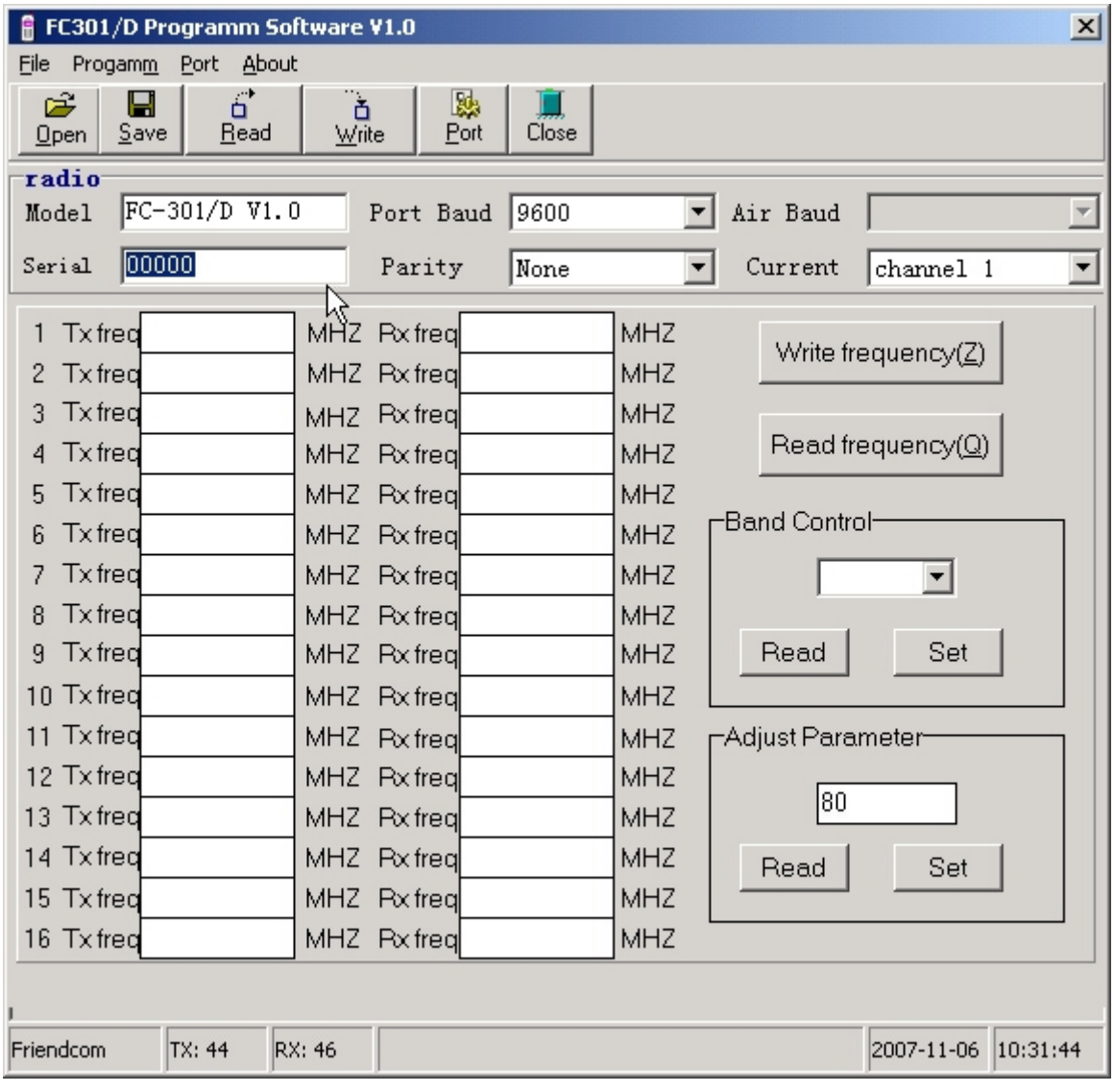
Model：Only for check, it can not be changed.

Serial No：Input 5 digits for ID code. Zero will be added to the front. The value less than 65536.

Port Baud：Optional from the list box

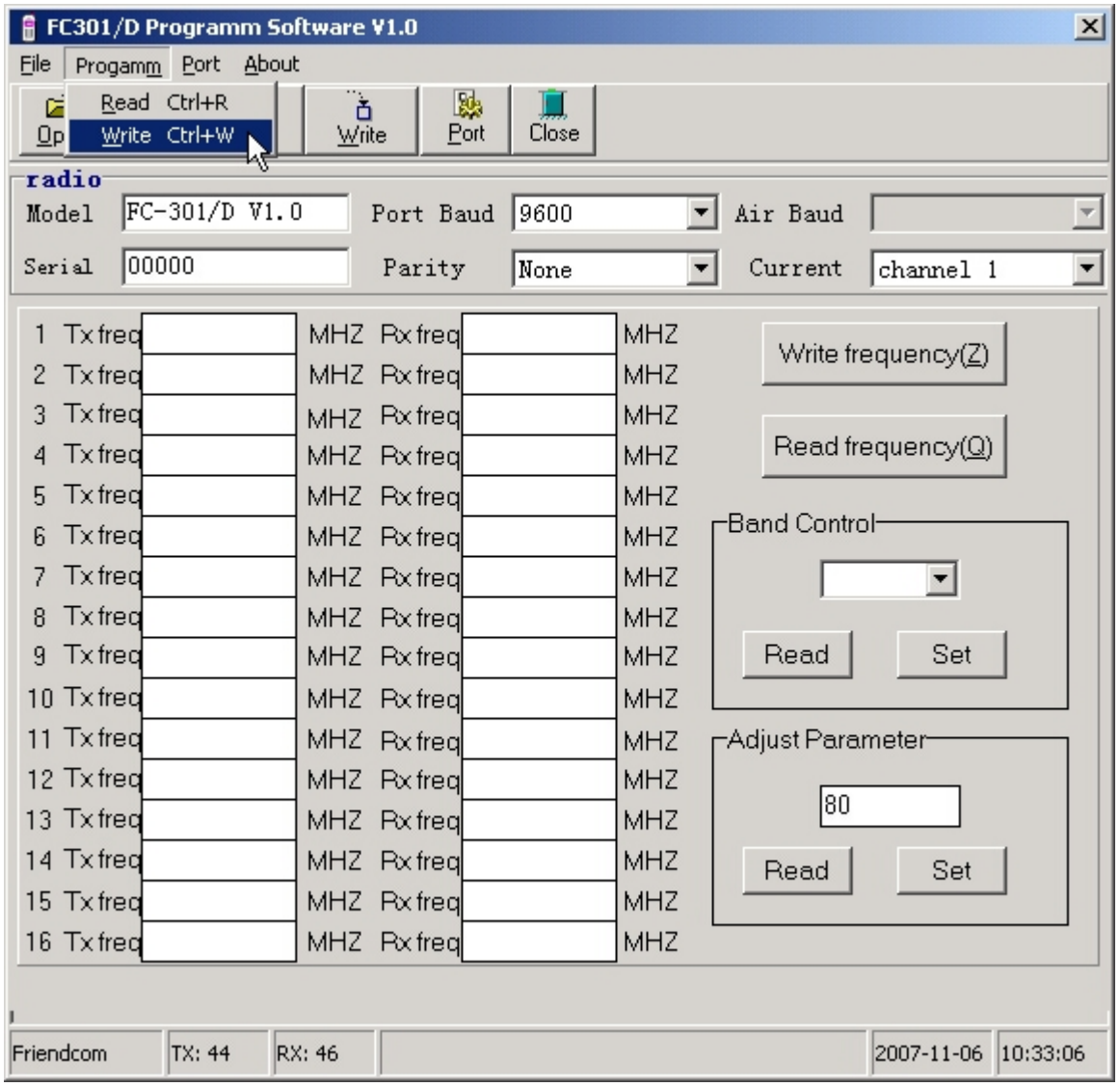
Parity： Optional from the list box

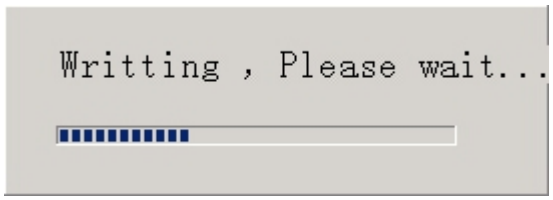
Channel： Only for check, it can not be changed



III. To write the parameters into the module

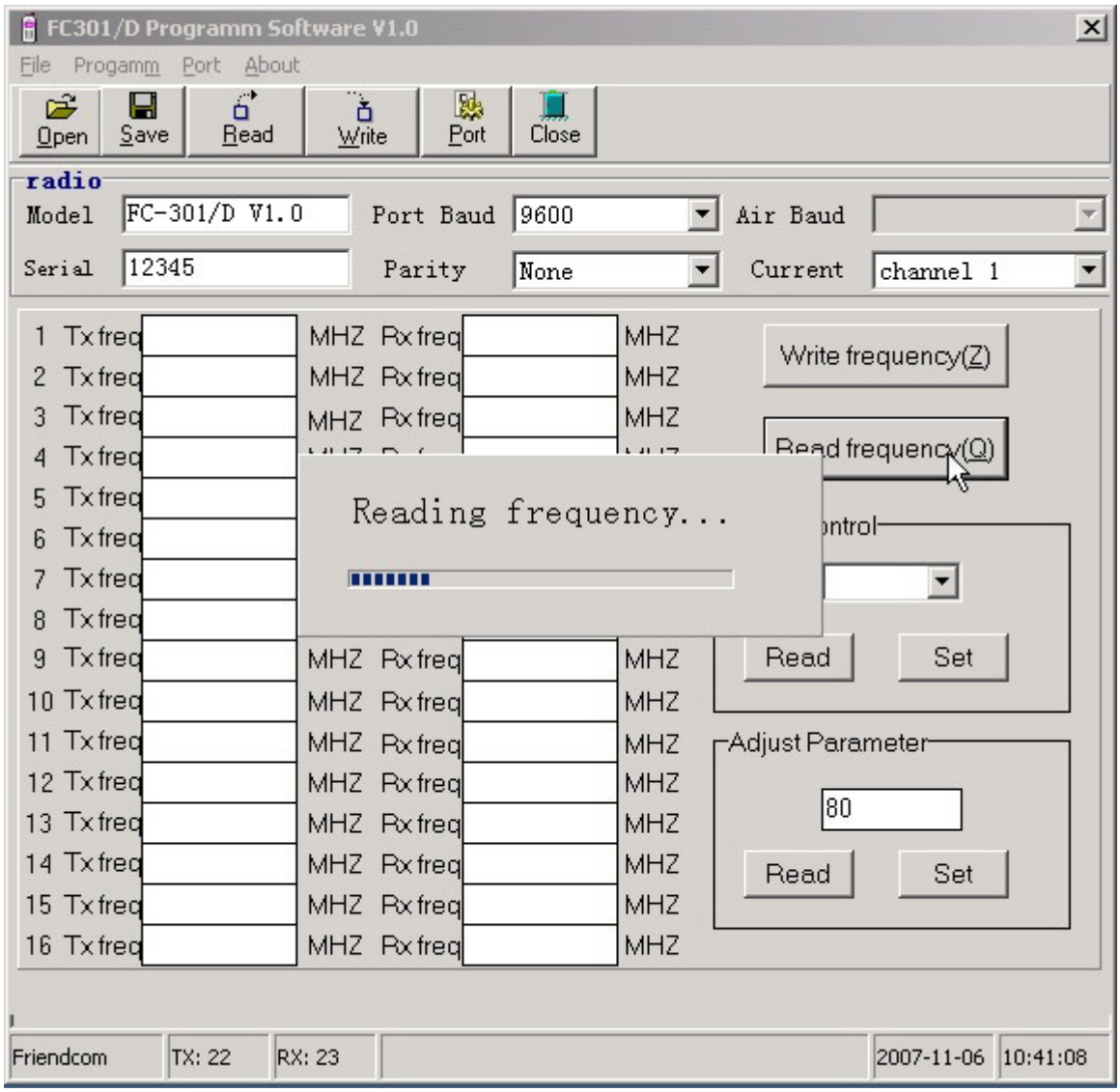
Run ‘Program’ -> ‘ Write ’ in the main menu, The changed parameters will be written into the FC-301/D module.

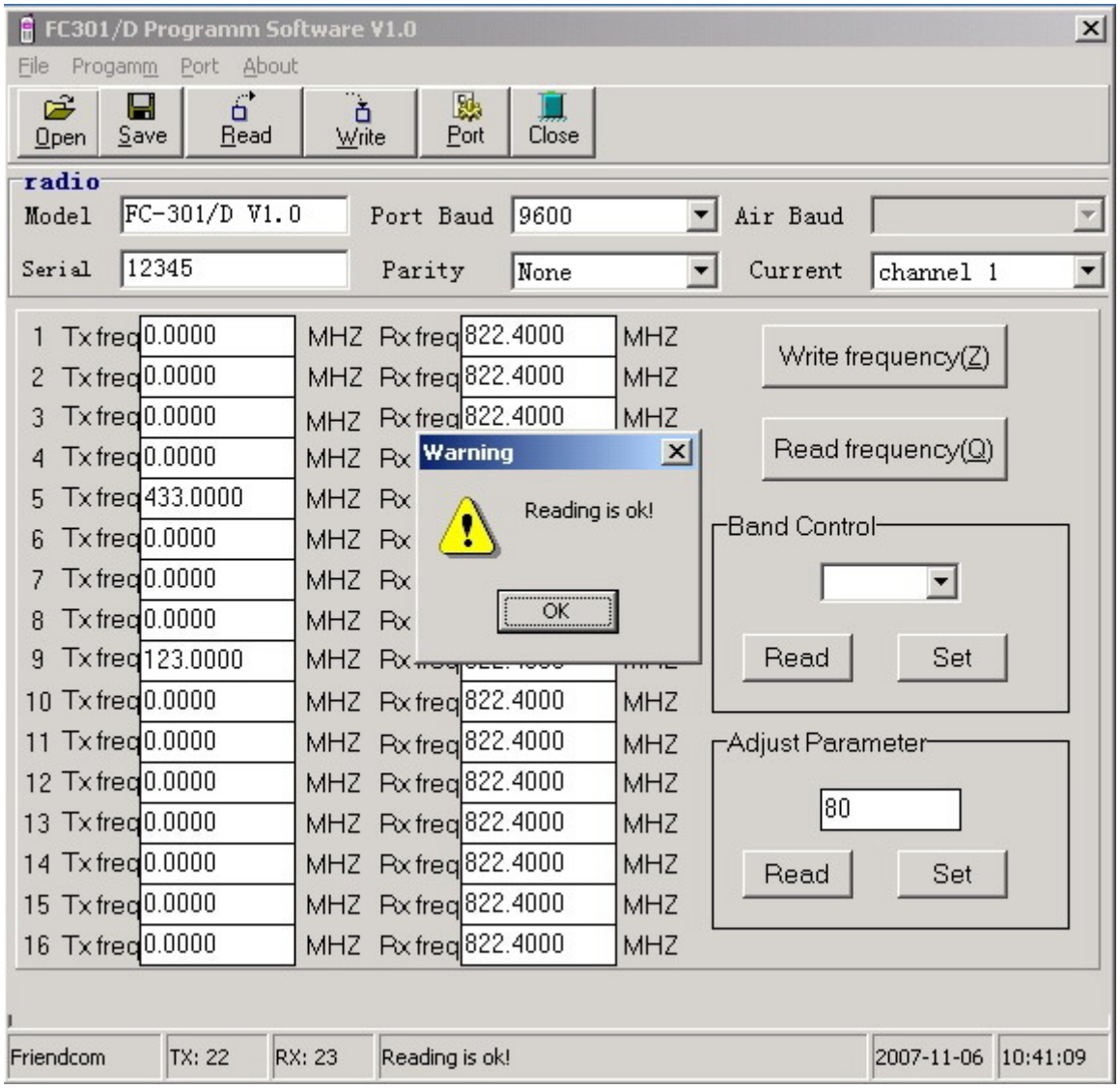




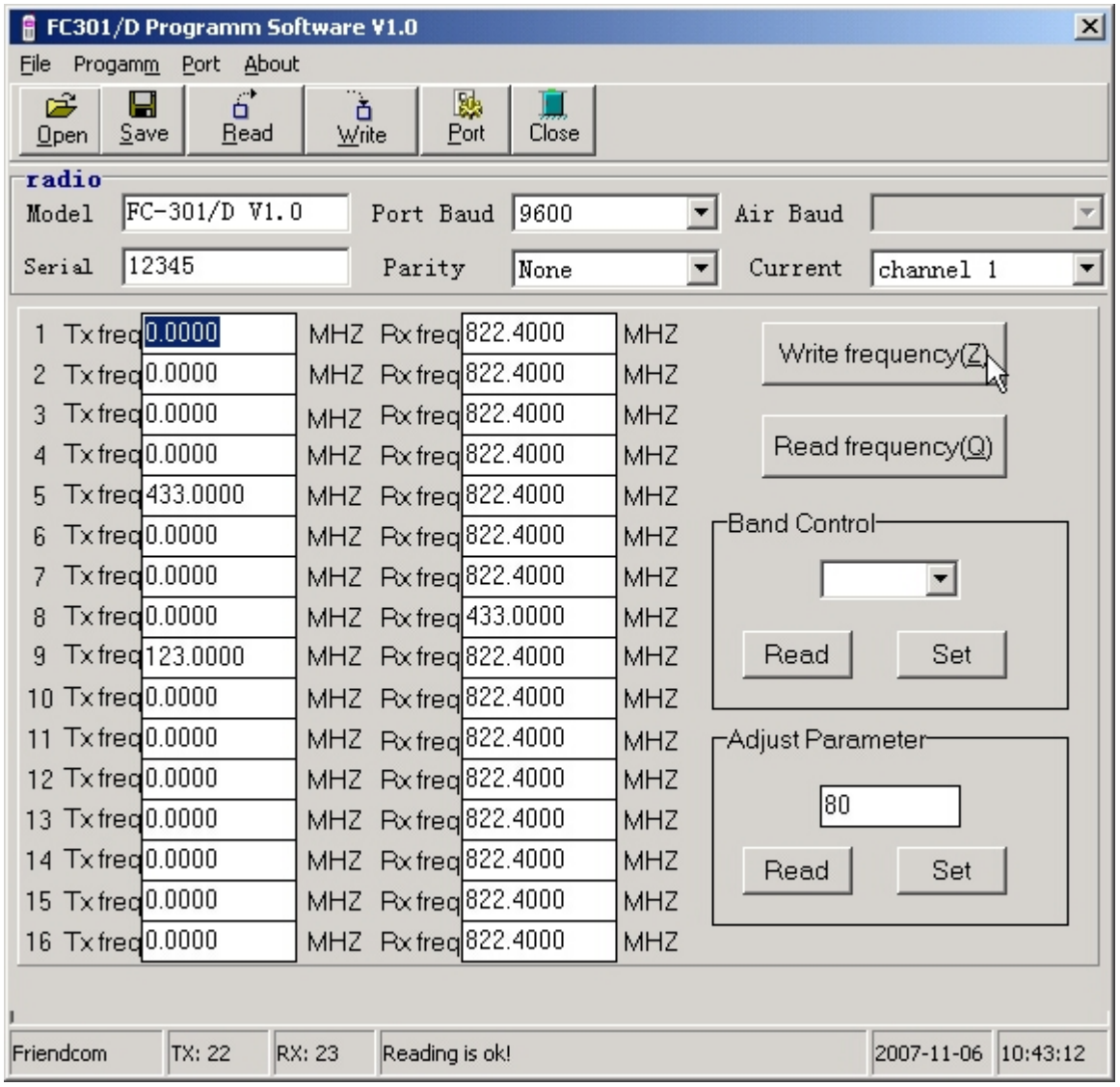
Ⅳ. To read / write the frequency

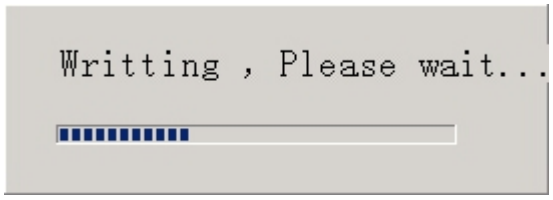
Click the button ‘Read Frequency’, the frequency of the channel from 1-16 will be displayed on the screen.

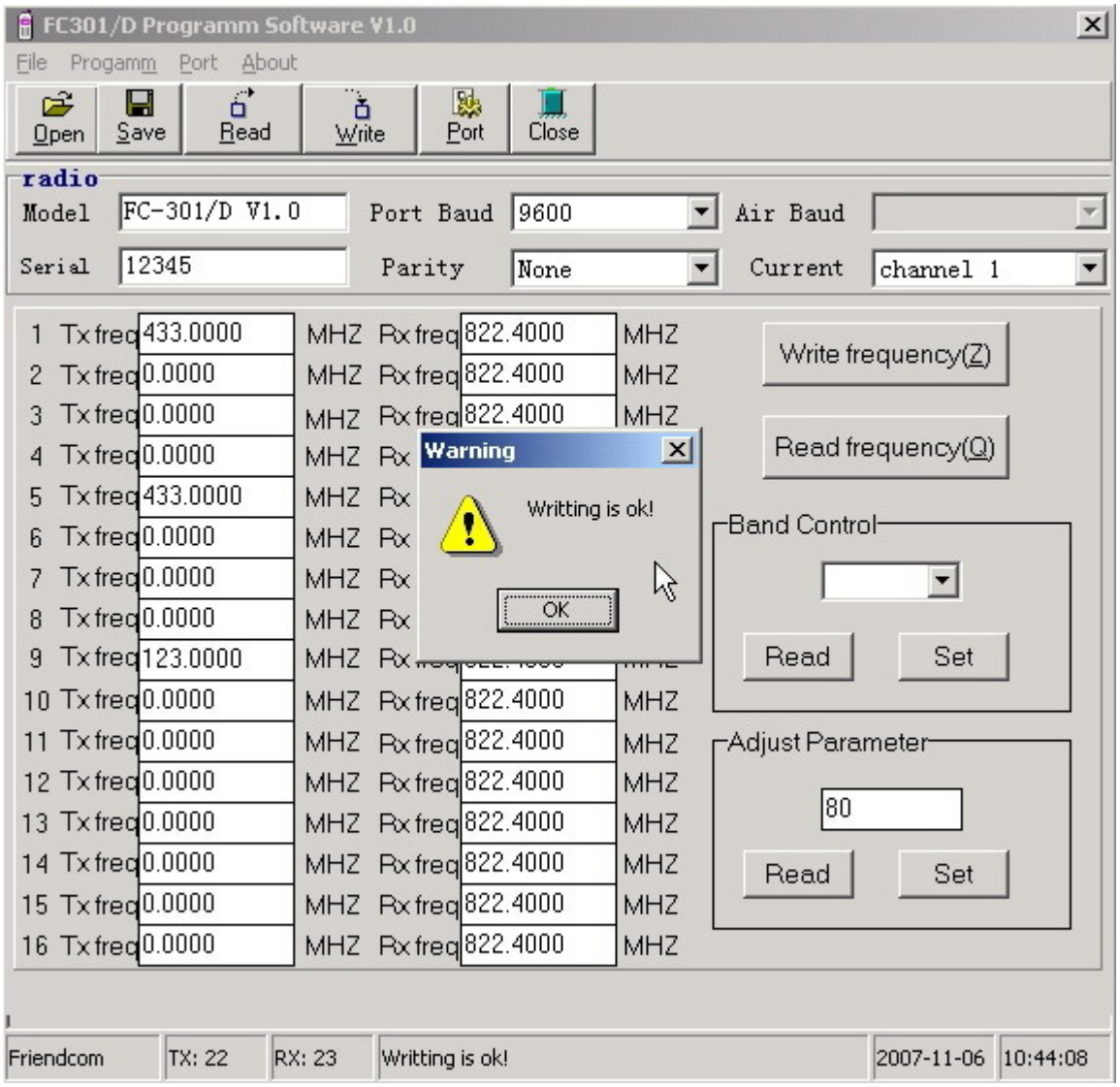



FC301/D Programm Software V1.0
File Progamm Port About
Open Save Read Write Port Close
radio
Model FC-301/D V1.0
Port Baud 9600
Air Baud
Serial 12345
Parity None
Current channel 1
1 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
2 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
3 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
4 Tx freq 0.0000 MHZ Rx
5 Tx freq 433.0000 MHZ Rx
6 Tx freq 0.0000 MHZ Rx
7 Tx freq 0.0000 MHZ Rx
8 Tx freq 0.0000 MHZ Rx
9 Tx freq 123.0000 MHZ Rx
10 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
11 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
12 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
13 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
14 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
15 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
16 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
Warning
Reading is ok!
OK
Write frequency(Z)
Read frequency(Q)
Band Control
Read
Set
Adjust Parameter
80
Read
Set
Friendcom
TX: 22
RX: 23
Reading is ok!
2007-11-06
10:41:09

New frequency can be input into each channel and click the ‘Write Frequency’ button, the new frequency will be written into the module.

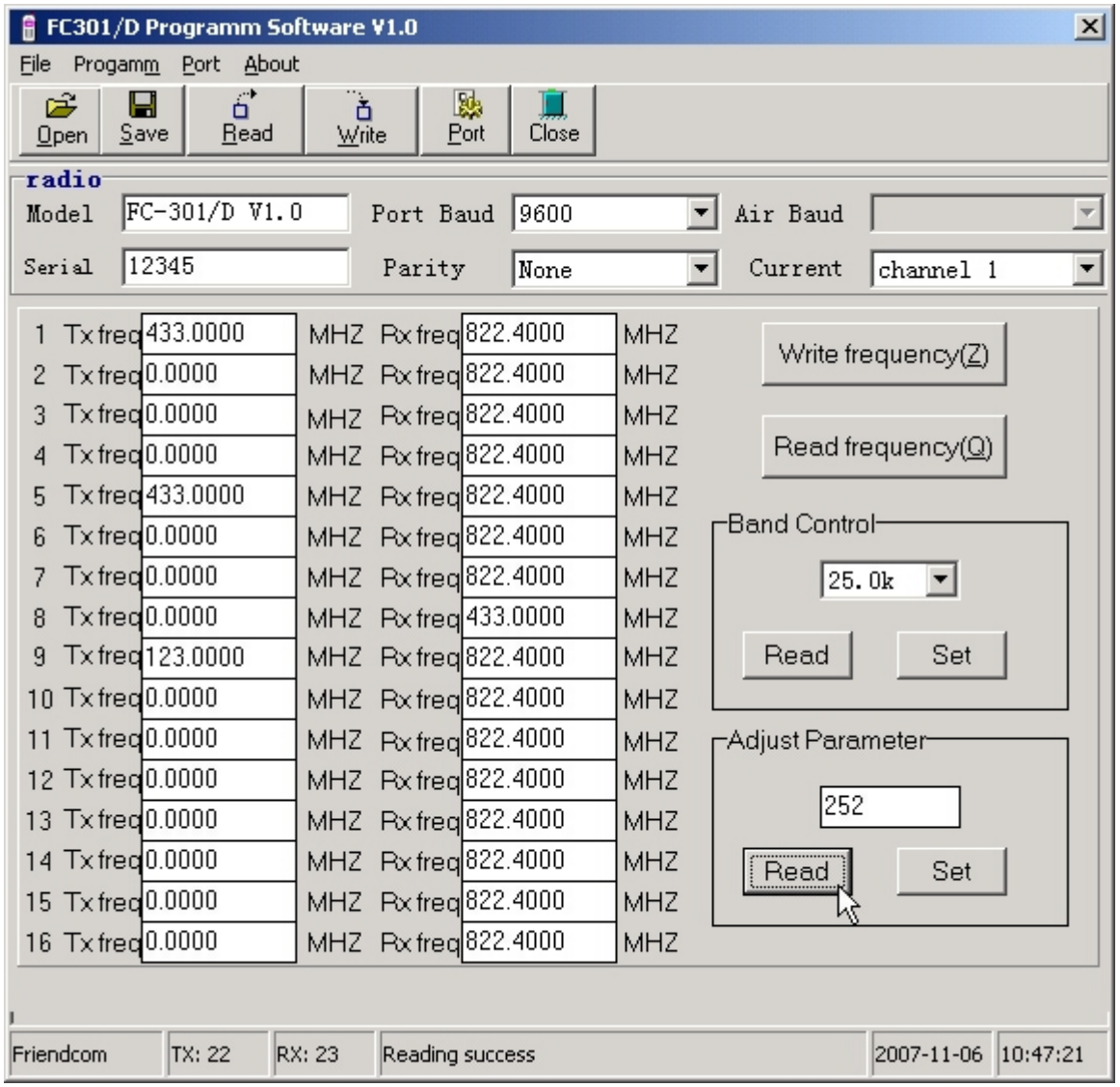





FC301/D Programm Software V1.0
File Progamm Port About
Open Save Read Write Port Close
radio
Model FC-301/D V1.0
Port Baud 9600
Air Baud
Serial 12345
Parity None
Current channel 1
1 Tx freq 433.0000 MHZ Rx freq 822.4000 MHZ
2 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
3 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
4 Tx freq 0.0000 MHZ Rx
5 Tx freq 433.0000 MHZ Rx
6 Tx freq 0.0000 MHZ Rx
7 Tx freq 0.0000 MHZ Rx
8 Tx freq 0.0000 MHZ Rx
9 Tx freq 123.0000 MHZ Rx
10 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
11 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
12 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
13 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
14 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
15 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
16 Tx freq 0.0000 MHZ Rx freq 822.4000 MHZ
Warning
Writting is ok!
OK
Write frequency(Z)
Read frequency(Q)
Band Control
Read
Set
Adjust Parameter
80
Read
Set
Friendcom
TX: 22
RX: 23
Writting is ok!
2007-11-06
10:44:08

Ⅴ. The switch between 12.5kHz and 25kHz channel spacing

In the ‘Band Control ’ interface, Click ‘Read’ , the current channel spacing 12.5kHz or 25kHz can be read out. Click ‘Set’, the selected channel spacing 12.5kHz or 25kHz can be written into the module.



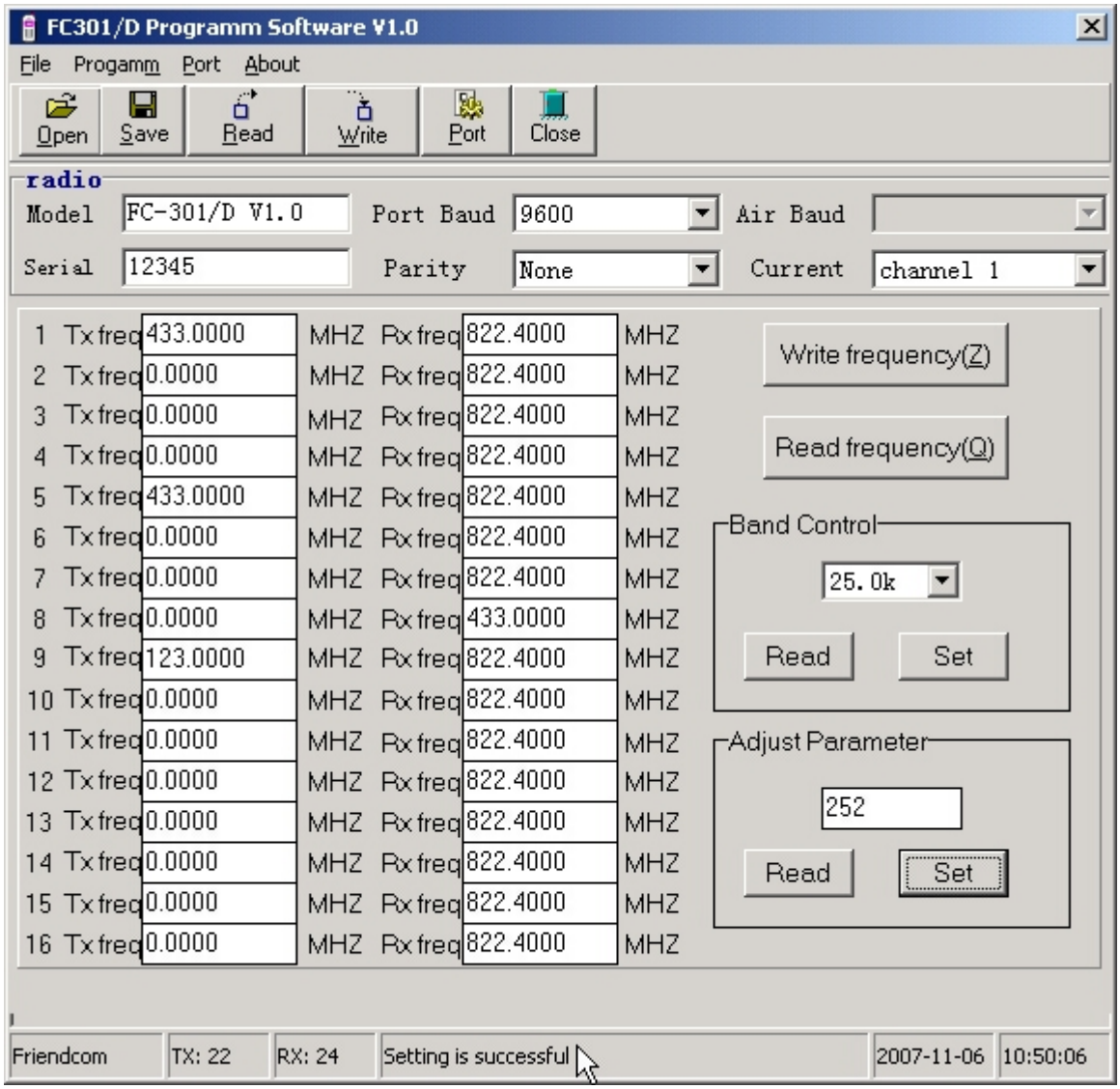
Ⅵ. To adjust the parameters

● While the module works in transmission or reception status on one fixed frequency, Click ‘Set’ in ‘Adjust Parameter’ to adjust the sensitivity or the RF power on one frequency. Click ‘Read’ to read the adjusted parameters of the current frequency.

● Tuning Value, the value range is between 0 and 255; when its value is 0, the corresponding voltage of CPU APC/TV pin is 4.0V, as the value increase the voltage of CPU APC/TV will decrease correspondingly. When its value is 255, the Voltage of CPU APC/TV pin is 0V. it is in inverse proportion relationship between two value.

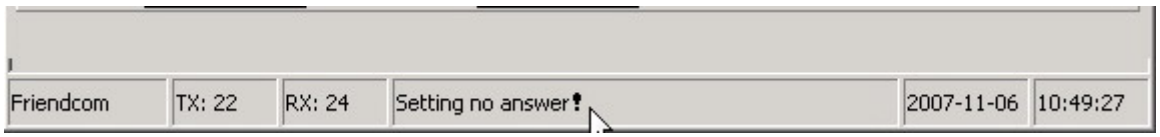
● Set tuning value of RX (TV Value)

Firstly adjust CON1 pin8 SW port to low level and change RF at the status of RX;



Secondly input the corresponding value in ‘Adjust Parameter’ according to channel frequency; you will see ‘Setting successful’ after you click ‘set’.

Otherwise you will see ‘Setting no answer’ which indicate setting fail.



Thirdly, after setting success you can wait for 10 seconds or switch channel button to make the newest parameter be stored in CPU.

● Read the Tuning Value of RX (TV Value)

Firstly adjust CON1 pin8 SW port to low level and change RF at the status of RX ;

Secondly click the button ‘Read’ in Adjust Parameter, you will see ‘Reading success’ message and the detail parameter below; otherwise you will see ‘Reading no answer’ and it indicate read failed it need to read again .(Without necessary please remember not to change the tuning value which have set in factory, otherwise it will affect other technologic parameter in RF)

● Set tuning value of TX (APC Value)

Firstly adjust CON1 pin8 SW port to low level and change RF at the status of RX ;

Secondly input the corresponding value in ‘Adjust Parameter’ according to channel output frequency; you will see ‘Setting successful’ after you click ‘set’. Otherwise you will see ‘Setting no answer’ which indicate setting fail.

Thirdly, after setting success you can switch channel button to make the newest parameter be stored in CPU.

● Read the Tuning Value of TX (TV Value)

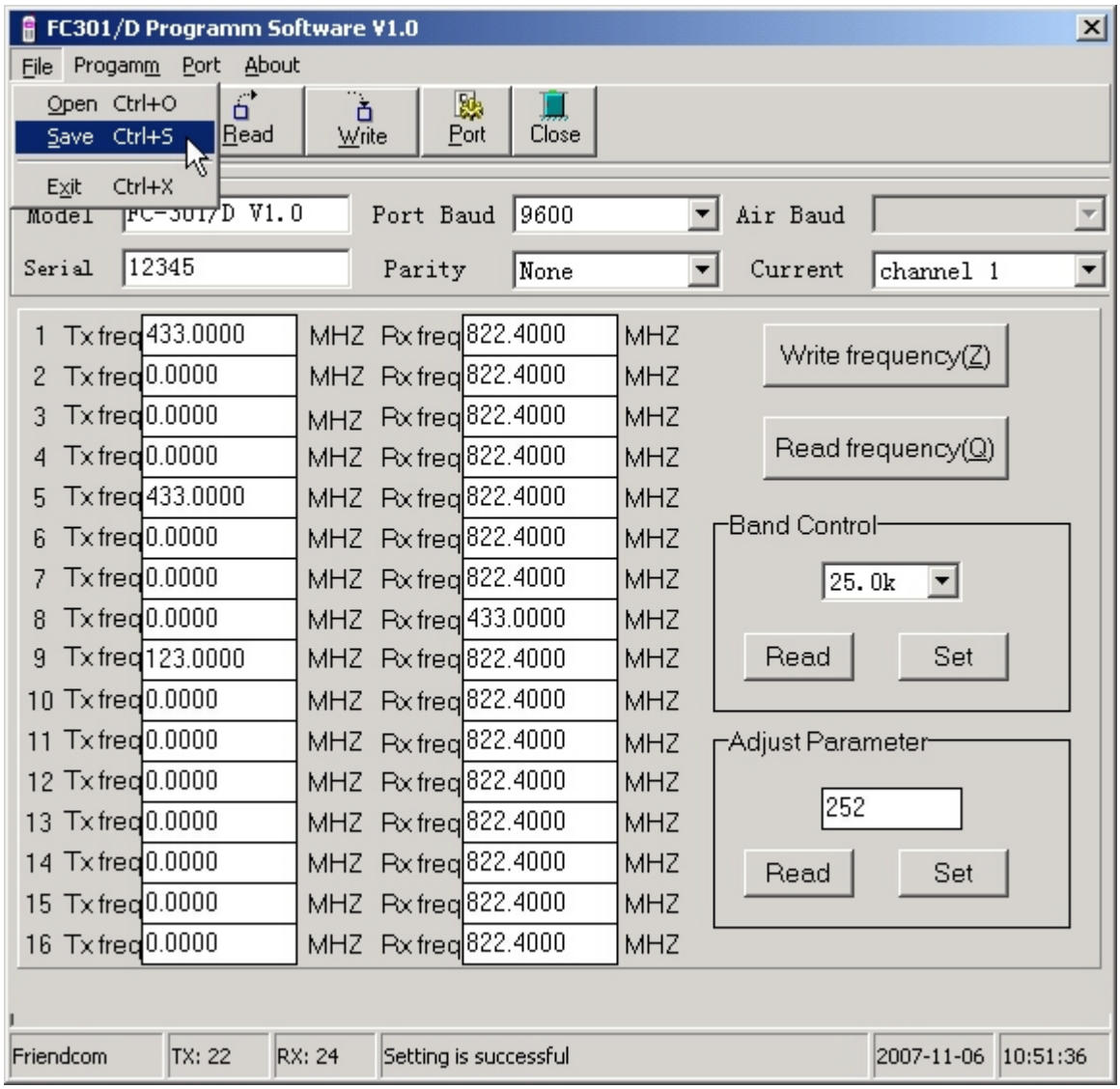
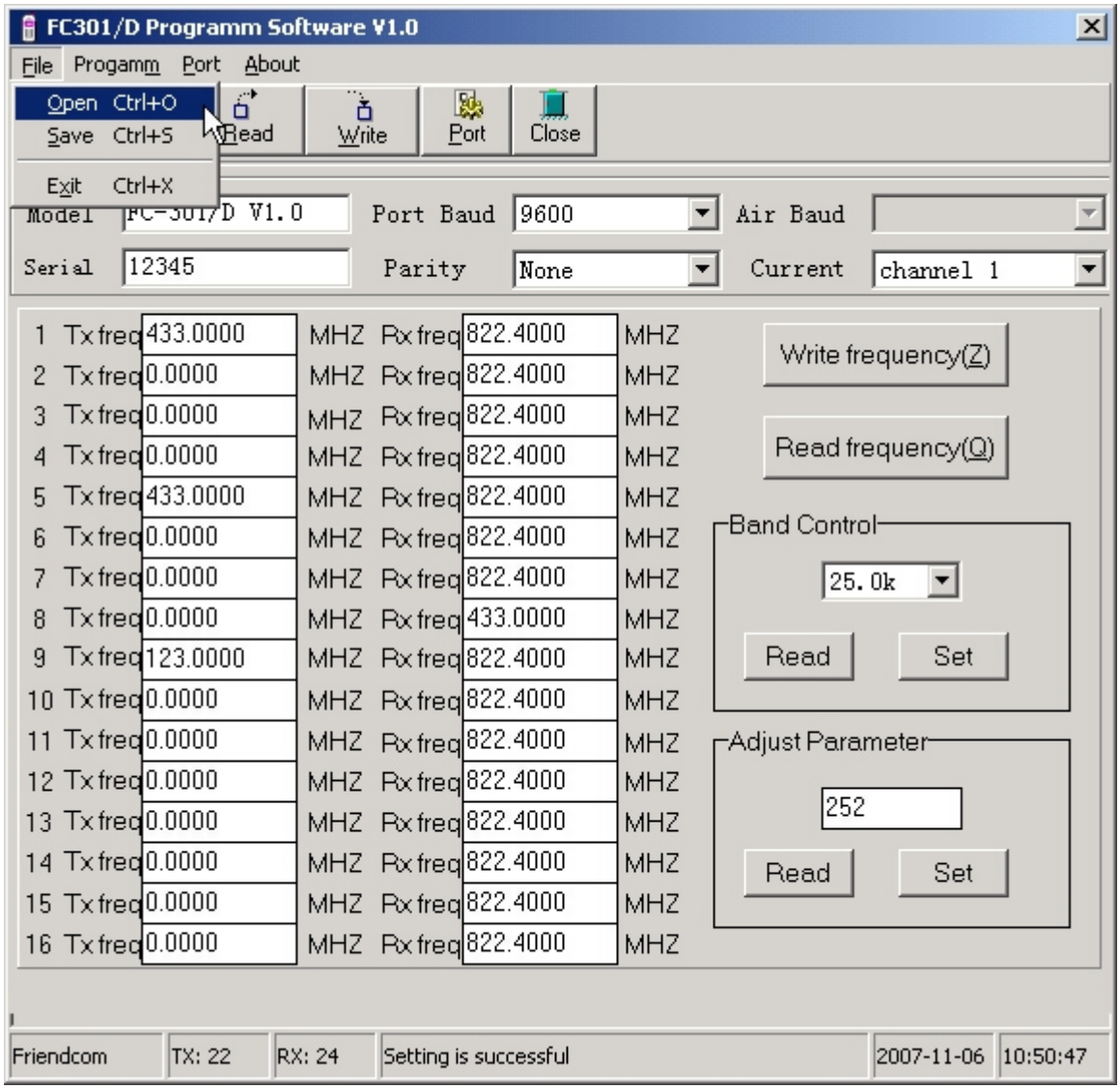
Firstly adjust CON1 pin8 SW port to low level and change RF at the status of TX;

Secondly click the button ‘Read’ in Adjust Parameter, you will see

‘Reading success’ message and the detail parameter below; otherwise you will see ‘Reading no answer’ and it indicate read failed and need to read again .

Ⅶ. To save or open parameter file

● Run ‘File’->‘Save’ menu, The ‘Save’ interface will be displayed on the screen, Input the file name for saving, and press ‘Save’ button, the current parameters of the module will be saved into the appointed file for later use.



● Run ‘File’->‘Open’ menu, The ‘open’ interface will be displayed on the screen, Choose the file name which saved the parameters, and press ‘Open’ button, the parameters of the module saved in the file will be displayed on the screen.